CLAIMS

[1]   A motion picture encoding/decoding system incorporating a means of encoding/decoding motion picture for sequentially encoding/decoding a motion picture in the unit of frame formed of a plurality of successive frames by the use of a processor implemented with MOS transistors laminated on a semiconductor substrate and enabling the processor to control an operating frequency and a substrate bias voltage, which system is characterized by comprising a means of calculating necessary operation volume for calculating the volume of operation necessary for encoding/decoding the present frame and a means of deciding substrate bias voltage and operating frequency for deciding a substrate bias voltage and an operating frequency capable of encoding/decoding the volume of necessary operation within a time allocated in advance to the process for encoding/decoding the present frame and permitting the processor to operate steadily in the unit of frame with the substrate bias voltage and the operating frequency decided by the means of deciding substrate bias voltage-operating frequency while causing the means of encoding/decoding motion picture to perform the process of encoding/decoding the present frame.

[2]   A motion picture encoding/decoding system incorporating a means of encoding/decoding motion picture for sequentially encoding/decoding in the unit of frame a motion picture formed of a plurality of successive frames by the use of a processor implemented with MOS transistors laminated on a semiconductor substrate and enabling the processor to control an operating frequency and a substrate bias voltage and a power-supply voltage, which system is characterized by comprising a means of calculating necessary operation volume for calculating the volume of operation necessary for encoding/decoding the present frame and a means of deciding power-supply voltage, substrate bias voltage and operating frequency for deciding a power-supply voltage and a substrate bias voltage and an operating frequency capable of encoding/decoding the volume of necessary operation within a time allocated in advance to the process for encoding/decoding the present frame and permitting the processor to operate steadily in the unit of frame with the substrate bias voltage, the power-supply voltage, and the operating frequency decided by the means of deciding power-supply voltage, substrate bias voltage and operating frequency while causing the means of encoding/decoding motion picture to perform the process of encoding/decoding the present frame.

[3]   A motion picture encoding/decoding system according to claim 1, wherein the processor allows the operating frequency thereof to vary in r steps (r denoting an integer of not less than 2) and the means of deciding substrate bias voltage-frequency calculates the operating frequency Fe necessary for processing the necessary operation volume Kp with the time Te by the formula Fe = Kp/Te using the necessary operation volume Kp of the present frame calculated by the means of calculating necessary operation volume and the time Te allocated to the processing of the present frame, selects from the operating frequencies available for the operation of the processor an operating frequency exceeding the necessary operating frequency Fe mentioned above and approximating most closely to the operating frequency Fe, and decides a substrate bias voltage suitable for the selected operating frequency.

[4]   A motion picture encoding/decoding system according to claim 2, wherein the processor allows the operating frequency thereof to vary in r steps (r denoting an integer of not less than 2) and the means of deciding power-supply voltage, substrate bias voltage and operating frequency calculates the operating frequency Fe necessary for processing the necessary operation volume Kp with the time Te by the formula Fe = Kp/Te using the necessary operation volume Kp of the present frame calculated by the means of calculating necessary operation volume and the time Te allocated to the processing of the present frame, selects from the operating frequencies available for the operation of the processor an operating frequency exceeding the necessary operating frequency Fe mentioned above and approximating most closely to the operating frequency Fe, and decides a power-supply voltage and a substrate bias voltage suitable for the selected operating frequency.

[5]   A motion picture encoding/decoding system according to any of claims 1 through 4, which is provided with a means of avoiding failure situation for avoiding the failure situation which occurs when the necessary operation volume calculated by the means of calculating necessary operation volume is smaller than the actually necessary volume of operation.

[6]   A motion picture encoding/decoding system according to claim 5, which is provided as the means of avoiding failure situation with a first means of avoiding failure situation for enabling the necessary operation volume calculated by the means of calculating necessary operation volume to be increased by a prescribed value.

[7]   A motion picture encoding/decoding system according to claim 6, wherein the first means of avoiding failure situation allows the necessary operation volume calculated by the means of calculating necessary operation volume to be multiplied to m folds (m denoting an integer of not less than 1) or to be added with a real number n which is larger than 0.

[8]   A motion picture encoding/decoding system according to claim 5, which is provided as the means of avoiding failure situation with a second means of avoiding failure situation for judging whether or not the necessary operation volume calculated by the means of calculating necessary operation volume is smaller than the volume of operation actually necessary for the process of encoding/decoding performed by the means of encoding/decoding motion picture and, when the calculated volume of operation is judged to be smaller, performing a process for avoiding the failure situation.

[9]   A motion picture encoding system according to claim 8, which is provided as the second means of avoiding failure situation at least with a means of invalidating blocks for interrupting the process of encoding with the means of encoding motion picture at a prescribed timing and, when a macro block which has escaped the encoding is detected, effecting a block invalidating process on the macro block.

[10]   A motion picture encoding/decoding system according to claim 8, which is provided as the second means of avoiding failure situation at least with a means of judging residual operation volume interrupting the process of encoding/decoding performed by the means of encoding/decoding motion picture at a prescribed timing and, when the residue of the necessary operation volume of the present frame calculated by the means of calculating necessary operation volume is smaller at the time of the interruption than the residue of the volume of operation actually necessary for the process of encoding/decoding the present frame performed by the means of encoding/decoding, increasing the operating frequency of the processor, and operating the processor with a substrate bias voltage suitable for the operating frequency.

[11]   A motion picture encoding/decoding system according to claim 8, which is provided as the second means of avoiding failure situation at least with a means of judging residual operation volume interrupting the process of encoding/decoding performed by the means of encoding/decoding motion picture at a prescribed timing and, when the residue of the necessary operation volume of the present frame calculated by the means of calculating

necessary operation volume is smaller at the time of the interruption than the residue of the volume of operation actually necessary for the process of encoding/decoding the present frame performed by the means of encoding/decoding, increasing the operating frequency of the processor, and operating the processor with a power-supply voltage and a substrate bias voltage suitable for the operating frequency.

[12] A motion picture encoding/decoding system according to any of claims 1 through 11, wherein the means of calculating necessary operation volume in the case of encoding a motion picture, on the assumption that of a plurality of successive frames, those which are subjected to a process of encoding prior to the present frame will be named previous frame, performs the calculation of the necessary operation volume by using not less than one important factor selected from the group consisting of amounts of movement of the present frame and the previous frame, amount of activity of the present frame, amount of activity of the previous frame, average value of the quantizing step size of the previous frame, difference between the average value of the quantizing step size of the previous frame and the average value of the quantizing step size of the frame directly before the previous frame, the number of times of macro matching of the previous frame, the number of valid blocks of the previous frame, the number of valid coefficients of the previous frame, amount of operation actually required for encoding the previous frame, the number of bits occurring in the previous frame, encoding bit rate of the present frame, kind of the present frame as to discrimination between intra-frame encoding and inter-frame encoding, and necessary operation volume calculated by the means of calculating necessary operation volume.

[13] A motion picture encoding/decoding system according to any of claims 1 through 11, wherein the means of calculating necessary operation volume in the case of encoding a motion picture, on the assumption that of a plurality of successive frames, those which are subjected to a process of encoding prior to the present frame will be named previous frame, performs the calculation of the necessary operation volume by using not less than one important factor selected from the group consisting of the number of bits of the encoded data of the present frame, kind of the present frame as to discrimination between intra-frame encoding and inter-frame encoding, average value of the size of movement vector of the present frame or the previous frame, dispersion of the size of movement vector of the

present frame or the previous frame, the number of valid blocks of the present frame or the previous frame, the number of valid coefficients of the present frame or the previous frame, bit rate of the present frame or the previous frame, amount of signs of the present frame or the previous frame, average value of the quantizing step size of the present frame or the previous frame, difference in the average value of the quantizing step size (difference in the quantizing step size between the present frame and the frame directly before the present frame or difference between the quantizing step size of the frame directly before and the quantizing step size of the frame before the present frame across an intervening frame), amount of operation actually required for decoding the previous frame, and necessary operation volume of the previous frame calculated by the means/step of calculating necessary operation amount.

[14] A motion picture encoding/decoding method for sequentially encoding/decoding in the unit of frame a motion picture formed of a plurality of successive frames by the use of a processor implemented with MOS transistors laminated on a semiconductor substrate and enabling the processor to control an operating frequency and a substrate bias voltage, which method is characterized by comprising a step of calculating necessary operation volume for calculating the volume of operation necessary for encoding/decoding the present frame and a step of deciding substrate bias voltage and operating frequency for deciding a substrate bias voltage and an operating frequency capable of encoding/decoding the volume of necessary operation within a time allocated in advance to the process for encoding/decoding the present frame, and a step of encoding/decoding motion picture for permitting the processor to operate steadily in the unit of frame with the substrate bias voltage and the operating frequency decided in the substrate bias voltage-operating frequency deciding step while performing the process for encoding/decoding the present frame.

[15] A motion picture encoding/decoding method for sequentially encoding/decoding in the unit of frame a motion picture formed of a plurality of successive frames by the use of a processor implemented with MOS transistors laminated on a semiconductor substrate and enabling the processor to control an operating frequency, a substrate bias voltage, and a power-supply voltage, which method is characterized by comprising a step of calculating necessary operation volume for calculating the volume of operation necessary for

encoding/decoding the present frame and a step of deciding power-supply voltage, substrate bias voltage and operating frequency for deciding a power-supply voltage, a substrate bias voltage, and an operating frequency capable of encoding/decoding the volume of necessary operation within a time allocated in advance to the process for encoding/decoding the present frame, and a step of encoding/decoding motion picture for permitting the processor to operate steadily in the unit of frame with the power-supply voltage, the substrate bias voltage, and the operating frequency decided in the step of deciding power-supply voltage, substrate bias voltage and operating frequency while performing the process for encoding/decoding the present frame.

[16] A motion picture encoding/decoding method according to claim 14, wherein the processor allows the operating frequency thereof to vary in r steps (r denoting an integer of not less than 2) and the step of deciding substrate bias voltage and operating frequency calculates the operating frequency Fe necessary for processing the necessary operation volume Kp with the time Te by the formula Fe = Kp/Te using the necessary operation volume Kp of the present frame calculated by the means of calculating necessary operation volume and the time Te allocated to the processing of the present frame, selects from the operating frequencies available for the operation of the processor an operating frequency exceeding the necessary operating frequency Fe mentioned above and approximating most closely to the operating frequency Fe, and decides a substrate bias voltage suitable for the selected operating frequency.

[17] A motion picture encoding/decoding method according to claim 15, wherein the processor allows the operating frequency thereof to vary in r steps (r denoting an integer of not less than 2) and the step of deciding power-supply voltage, substrate bias voltage and operating frequency calculates the operating frequency Fe necessary for processing the necessary operation volume Kp with the time Te by the formula Fe = Kp/Te using the necessary operation volume Kp of the present frame calculated by the step of calculating necessary operation volume and the time Te allocated to the processing of the present frame, selects from the operating frequencies available for the operation of the processor an operating frequency exceeding the necessary operating frequency Fe mentioned above and approximating most closely to the operating frequency Fe, and decides a power-supply voltage and a substrate bias voltage suitable for the selected operating frequency.

[18]   A motion picture encoding/decoding method according to any of claims 14 through 17, which is provided with a step of avoiding failure situation for avoiding the failure situation which occurs when the necessary operation volume calculated by the step of calculating necessary operation volume is smaller than the actually necessary volume of operation.

[19]   A motion picture encoding/decoding method according to claim 18, which is provided as the step of avoiding failure situation with a first step of avoiding failure situation for enabling the necessary operation volume calculated by the step of calculating necessary operation volume to be increased by a prescribed value.

[20]   A motion picture encoding/decoding method according to claim 19, wherein the first step of avoiding failure situation allows the necessary operation volume calculated by the step of calculating necessary operation volume to be multiplied to m folds (m denoting an integer of not less than 1) or to be added with a real number n larger than 0.

[21]   A motion picture encoding/decoding method according to claim 18, which is provided as the step of avoiding failure situation with a second step of avoiding failure situation for judging whether or not the necessary operation volume calculated by the step of calculating necessary operation volume is smaller than the volume of operation actually necessary for the process of encoding/decoding performed by the means of encoding/decoding motion picture and, when the calculated volume of operation is judged to be smaller, performing a process for avoiding the failure situation. .

[22]   A motion picture encoding method according to claim 21, which is provided as the second step of avoiding failure situation at least with a step of invalidating blocks for interrupting the process of encoding with the step of encoding motion picture at a prescribed timing and, when a macro block which has escaped the encoding is detected, effecting a block invalidating process on the macro block.

[23]   A motion picture encoding/decoding method according to claim 21, which is provided as the second step of avoiding failure situation at least with a step of judging residual operation volume interrupting the process of encoding/decoding performed by the motion picture step of encoding/decoding at a prescribed timing and, when the residue of the necessary operation volume of the present frame calculated by the step of calculating necessary operation volume is smaller at the time of the interruption than the residue of the volume of operation actually necessary for the process of encoding/decoding the present

frame performed by the step of encoding/decoding, increasing the operating frequency of the processor, and operating the processor with a substrate bias voltage suitable for the operating frequency.

[24] A motion picture encoding/decoding method according to claim 21, which is provided as the second step of avoiding failure situation at least with a step of judging residual operation volume interrupting the process of encoding/decoding performed by the motion picture step of encoding/decoding at a prescribed timing and, when the residue of the necessary operation volume of the present frame calculated by the step of calculating necessary operation volume is smaller at the time of the interruption than the residue of the volume of operation actually necessary for the process of encoding/decoding the present frame performed by the step of encoding/decoding, increasing the operating frequency of the processor, and operating the processor with a power-supply voltage and a substrate bias voltage suitable for the operating frequency.

[25] A motion picture encoding/decoding method according to any of claims 14 through 24, wherein the step of calculating necessary operation volume in the case of encoding a motion picture, on the assumption that of a plurality of successive frames, those which are subjected to a process of encoding prior to the present frame will be named previous frame, performs the calculation of the necessary operation volume by using not less than one important factor selected from the group consisting of amounts of movement of the present frame and the previous frame, amount of activity of the present frame, amount of activity of the previous frame, average value of the quantizing step size of the previous frame, difference between the average value of the quantizing step size of the previous frame and the average value of the quantizing step size of the frame directly before the previous frame, the number of times of macro matching of the previous frame, the number of valid blocks of the previous frame, the number of valid coefficients of the previous frame, amount of operation actually required for encoding the previous frame, the number of bits occurring in the previous frame, encoding bit rate of the present frame, kind of the present frame as to discrimination between intra-frame encoding and inter-frame encoding, and necessary operation volume calculated by the means of calculating necessary operation volume.

[26]   A motion picture encoding/decoding method according to any of claims 14 through 24, wherein the step of calculating necessary operation volume in the case of encoding a motion picture, on the assumption that of a plurality of successive frames, those which are subjected to a process of encoding prior to the present frame will be named previous frame, performs the calculation of the necessary operation volume by using not less than one important factor selected from the group consisting of the number of bits of the encoded data of the present frame, kind of the present frame as to discrimination between intra-frame encoding and inter-frame encoding, average value of the size of movement vector of the present frame or the previous frame, dispersion of the size of movement vector of the present frame or the previous frame, the number of valid blocks of the present frame or the previous frame, the number of valid coefficients of the present frame or the previous frame, bit rate of the present frame or the previous frame, amount of signs of the present frame or the previous frame, average value of the quantizing step size of the present frame or the previous frame, difference in the average value of the quantizing step size (difference in the quantizing step size between the present frame and the frame directly before the present frame or difference between the quantizing step size of the frame directly before and the quantizing step size of the frame before the present frame across an intervening frame), amount of operation actually required for decoding the previous frame, and necessary operation volume of the previous frame calculated by the step of calculating necessary operation amount.